



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/536,828	05/27/2005	Makoto Kitabatake	071971-0251	6640
20277 7590 01/22/2008 MCDERMOTT WILL & EMERY LLP 600 13TH STREET, N.W. WASHINGTON, DC 20005-3096			EXAMINER KALAM, ABUL	
			ART UNIT 2814	PAPER NUMBER
			MAIL DATE 01/22/2008	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/536,828	Applicant(s) KITABATAKE ET AL.	
	Examiner ABUL KALAM	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 November 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 and 8-19 is/are pending in the application.
- 4a) Of the above claim(s) 5,6 and 8-14 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 15-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>10/26/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 15, 2007, has been entered.

In the remarks filed on November 15, 2007, Applicant states on page 7:

"Please note that new claims 16-19 correspond to withdrawn claims 8-11. Withdrawn claims 8-11 also belong to Species I according to page 2 of the restriction requirement, and claims 8-11 were erroneously not elected. However, new claim 16 (corresponding to withdrawn claim 8) is slightly different from the withdrawn claim 8 because the term "the upper or lower surface of" has been added. No new matter is added."

The Office acknowledges that claims 16-19 read on the elected species of FIGs. 5-9, and thus, the new claims will be examined in this Office Action. Accordingly, withdrawn claims 8-11, which correspond to claims 16-19, should be cancelled. Furthermore, note that claims 5 and 6, which were previously examined, are directed to the species of FIG. 10, and not the elected species of FIGs. 5-9. Thereby, claims 5 and 6 will be withdrawn from further consideration, because they are drawn to a non-elected invention. Thus, claims 1-4 and 15-19 are given full consideration in this Office Action.

Claim Objections

2. Claims 1 and 15 are objected to because of the following informalities:

In lines 5-6 of claim 1, the limitations of "one main face of said semiconductor chip" and "the other main face of said semiconductor chip," respectively, should be amended to "a lower surface of the semiconductor chip" and "an upper surface of said semiconductor chip," in order to clarify the sides of the semiconductor chip that the Applicant is claiming.

In lines 2-3 of claim 15, the limitation of "the one main face of said semiconductor chip" should be amended to "the lower surface of said semiconductor chip."

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-4 and 15-19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In lines 7-8 of claim 1, the limitation of "a heat conducting member coming in contact with a part of the other main face of said semiconductor chip and releasing heat directly from said semiconductor chip without by way of said base material," is unclear and ambiguous because the phrase "without by way of said base material." Is the Applicant claiming that the heat conducting member releases the heat generated from the semiconductor chip without using the base material? Or is the Applicant claiming

that heat generated from the chip is not released through the base material? Note, in the specification on page 6, line 2-3, Applicant states: "the amount of heat transmitted to the external connection terminal is small." The connection terminal, as described by the Applicant, is a part of the base material, and thus, according to Applicant's specification, the base material is used to release at least some heat from the semiconductor chip. For examination purposes, lines 6-8 of claim 1, will be interpreted as: "a heat conducting member coming in contact with a part of an upper surface of said semiconductor chip and releasing heat directly from said semiconductor chip." Claims 2-4 and 15-19 depend from claim 1, and thus, are also rejected for the same reasons.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. **Claims 1-3, 15, 16, 18 and 19** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin (US 6,184,580)** in view of **Litwin (US 6,507,047)**.

With respect to **claim 1**, and as best interpreted by the Office, **Lin** teaches a semiconductor apparatus (**FIGs. 3-4**) comprising:

a semiconductor chip (**20, FIG. 3; col. 3: ln. 58**);

a base material **(36, FIG. 3; col. 3: Ins. 62-64)** made of an electrically conductive material and electrically connected **(through wires 25 and 27)** to a part of a lower surface **(21)** of said semiconductor chip **(20)**;

a heat conducting member **(26, FIG. 3; col. 3: In. 62)** coming in contact with a part of an upper surface **(24)** of said semiconductor chip **(20)** and releasing heat directly from said semiconductor chip **(col. 5: Ins. 8-19)**;

an encapsulating material **(28, FIG. 3; col. 4: Ins. 56-62)** for encapsulating said semiconductor chip **(20)** and said heat conducting member **(26)**;

wherein a part **(34, FIG. 4; col. 4: Ins. 13-14)** of said base material **(36)** is extruded outside said encapsulating material **(28)** and works as an external connection terminal **(34, FIG. 4)**;

wherein a first intermediate member **(30, FIG. 3)** made of an electrically conductive material **(col. 5: Ins. 38-41, col. 6: Ins. 25-26)** and a second intermediate member **(mold 28 provided between base material 36 and chip 20)** made of a material having lower heat conductivity **(col. 4: Ins. 61-62)** than said first intermediate member **(first intermediate member 30 is made of copper or aluminum while second intermediate member is made of epoxy resin)** are provided between said base material **(36)** and said semiconductor chip **(20, FIG. 3)**.

Thus, **Lin** teaches all the limitations of the claim with the exception of disclosing: wherein the semiconductor chip includes a power semiconductor device constructed by using wide band gap semiconductor.

However, **Litwin** discloses semiconductor chips containing power transistors constructed by using wide band gap semiconductor material (**SiC**) (**col. 1: Ins. 35-67**). **Litwin** discloses that transistors based on silicon carbide, which is a well known wide bandgap semiconductor, are another alternative to transistors based on Si or GaAs for power applications at high frequencies.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the semiconductor chip of **Lin** to include wide band gap semiconductor devices, as taught by **Litwin**, because semiconductor devices based on silicon carbide (SiC) are capable of handling high power densities and can operate at high temperatures, thus improving the speed, reliability and performance of semiconductor chips (**col. 2: Ins. 1-10**).

With respect to **claim 2**, **Lin** and **Litwin** teach the semiconductor apparatus of claim 1, as set forth above. Regarding the limitation, "wherein said power semiconductor device has a region where a current passes at a current density of 50 A/cm² or more," Applicant has not shown such a claimed range to be critical and thus, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form a power semiconductor device with a current density as claimed because such current densities are common in high power applications.

With respect to **claim 3**, **Lin and Litwin** teach the semiconductor apparatus of claim 1 or 2, as set forth above. Furthermore, **Lin** teaches wherein said encapsulating material (**28, FIG. 3**) is made of resin (**col. 4: Ins. 60-62**), and said heat conducting member (**26, FIG. 3**) is exposed from said encapsulating material (**28**).

With respect to **claim 15**, **Lin and Litwin** teach the semiconductor apparatus of claim 1, as set forth above. Furthermore, **Lin** teaches wherein another heat conducting member (**42, FIG. 3**) is in direct contact with the lower face (**21**) of said semiconductor chip (**20**).

With respect to **claim 16**, **Lin and Litwin** teach wherein a contact area (**23, FIG.3**) between said semiconductor chip (**20**) and said base material (**36**) is smaller than a half of an area of the upper or lower surface of said semiconductor chip (**20**).

With respect to **claim 18**, **Lin and Litwin** teach the semiconductor apparatus of claim 1, as set forth above. Furthermore, **Lin** teaches wherein said external connection terminal (**34, FIG. 4**) of said base material (**36**) is constructed to be mounted on a print wiring board (**60; col. 4: Ins. 19-21**).

With respect to **claim 19**, **Lin and Litwin** teach the semiconductor apparatus of claim 1, as set forth above. Furthermore, **Litwin** teaches wherein said wide band gap semiconductor is SiC (**col. 1: Ins. 63-66**).

5. **Claims 4 and 17** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin (US 6,184,580)** and **Litwin (US 6,507,047)**, as applied to claim 3 above, and further in view of **Huang (US 2001/0045644)**.

With respect to **claim 4**, **Lin and Litwin** teach the all the limitations of the claim, as set forth above in claim 3, with the exception of disclosing: the apparatus further comprising a radiation fin that is in contact with said heat conducting member and is extruded outside said encapsulating material.

However, Huang teaches a semiconductor package wherein a radiation fin (**260**, **FIG. 5**) is in contact with a heat conducting member (**210**) and is extruded outside an encapsulating material (**242**, **FIG. 5**; ¶ [0026]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of **Huang** into the device of **Lin and Litwin**, thus adding a radiation fin to the apparatus, for the disclosed intended purpose of further improving the heat-dissipating effect (¶ [0026]).

With respect to **claim 17**, **Lin and Litwin** do not disclose wherein: "said power semiconductor device is a vertical element, and said semiconductor apparatus further comprises another semiconductor chip that is stacked on said semiconductor chip and a part of which is connected to said base material." However, **Huang** teaches wherein a semiconductor apparatus comprises two semiconductor chips (**330**, **340**; **FIG. 7**) stacked on each other and electrically connected to a base material (**320**). Regarding the limitation of wherein said power semiconductor device is a vertical element, note that vertical type transistors are well known and conventional in power semiconductor devices (**US 2002/0140067**: ¶ [0005]). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of **Huang**

into the device of **Lin and Litwin**, thus providing a stacked-chip package, which increases the functionality of the device without increasing the size of the package.

Response to Arguments

6. Applicant's arguments with November 15, 2007, have been considered but are not persuasive.

Applicant argues that projection 30 is not an intermediate member because it is not provided between said base material and said semiconductor chip. The argument is not persuasive, because FIGs. 3 and 4 clearly show that the structure 30 is provided between the base material 36 and the semiconductor chip 20.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ABUL KALAM whose telephone number is (571)272-8346. The examiner can normally be reached on Monday - Friday, 9 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. K./
Examiner, Art Unit 2814

/Phat X Cao/
Primary Examiner, Art Unit 2814